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PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-248897

(43)Date of publication of application : 17.09.1999

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(51)Int.Cl. G21K 5/04
A23L 3/26
A61L 2/08
B65B 55/02
H01J 37/30
H01J 37/302

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(21)Application number : 10-064818

(22)Date of filing : 27.02.1998

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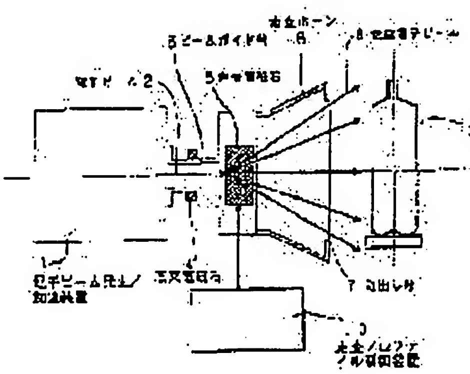
(54) ELECTRON BEAM IRRADIATION METHOD AND ITS DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an electron beam irradiation method and its device capable of unifying electron beam absorption dose in each part of scanning direction, avoiding uneven sterilization of a bottle and preventing degradation of quality by the electron beam irradiation in the case emitting electron beam to an object such as foods and drink bottles even if the objects have different thickness.



SOLUTION: An electron beam output from an electron beam generation means 1 is scanned by a scanning means and emitted to the object such as vessel 20 with different thickness at every part along the scanning direction. In this case, the scanning velocity of the electron beam is decreased at thick part of the object and increased at thin part to make the ratio of the electron beam transmission rate to the scanning velocity at each portion constant in the scanning direction in the object and to make the electron beam absorption dose of the object uniform.

LEGAL STATUS

TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to the electron-beam-irradiation method of irradiating repeating an electron ray in irradiated objects, such as food and a drink container, and carrying out a beam scan, and attaining the desired end, such as sterilization, and its equipment.

[Translation done.]

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Research and development in the method of irradiating an electron ray (electron beam) instead of the conventional heat sterilization means as a means to sterilize food and a drink container, carrying out a beam scan on a predetermined deflection square at a container, and sterilizing this container is being done in recent years. This electron-beam-pasteurization means is effective in sterilization of heat-resistant low resin containers, such as a PET bottle, etc.
[0003] Such beam scan type electron-beam-irradiation equipment is sterilizing by continuing and irradiating container 20 overall length which is an irradiated object, carrying out a deviation scan with a predetermined deflection angle and a predetermined period with the scanning electromagnet 5 at right and left, after converging the electron beam 2 by which outgoing radiation was carried out from electron beam generating / accelerator 1 in the diameter direction with the convergence electromagnet 4, as shown in drawing 1 .
[0004] And depending on voltage change which the scanning electromagnet 5 magnetic-field-strength-changes, and in other words is impressed to this scanning electromagnet 5, conventionally, in equipment, armature-voltage control of the scanning wave formed of the scanning angular velocity of the aforementioned electron beam 2 is carried out so that the aforementioned scanning wave may become a triangular wave or a sine wave (alternating current wave) from the ease of the armature-voltage control regardless of the thickness of an irradiated object.
[0005] In addition, time series change with the aforementioned scanning wave (angle theta) and angular velocity omega is shown in drawing 9 and drawing 10 . When the scanning angle theta is a sine wave as are shown in drawing 9 , and angular velocity omega serves as constant value which was able to be distributed to positive/negative in the shape of a square wave pulse when the scanning wave theta is a triangular wave, and shown in drawing 10 , angular velocity omega serves as this and a cosine wave which shifted 90-degree phase.
[0006] when [appropriate] it is alike, the scanning electron beam (scanning electron ray) 8 is repeated by such scanning wave, it scans a predetermined period and it irradiates, generally the drink containers 20 of the thickness of the regio oralis of a container or a pars basilaris ossis occipitalis, such as a PET bottle, are thick, since the thickness of the fuselage section is thin, the amount of electron ray transparency of a heavy-gage part is small, the amount of transparency of a thin-walled part becomes large, and the electron ray absorbed dose inside a container does not serve as homogeneity In this case, since the electron ray absorbed dose required for sterilization is beyond a certain decided value, if it is going to secure a complement in a heavy-gage circles side, the electron ray absorbed dose of a thin-walled part will become excessive, and will produce bad influences, such as the weakened bottle quality of the material and discoloration. On the other hand, when securing the electron ray absorbed dose of a limit required for a thin-walled part inside, the bad influence from which the electron ray absorbed dose of a heavy-gage part becomes insufficient, and it becomes inadequate sterilizing it will be produced.
[0007] In a thing this invention is irradiated repeating an electron ray in the predetermined direction in irradiated objects, such as food and a drink container, and carrying out a beam scan in view of the technical problem of this conventional technology, and attains the desired end, such as sterilization, -- It aims at offering the electron-beam-irradiation method that equalization of the electron ray absorbed dose of each part grade of a scanning direction is enabled, and there is no sterilization unevenness, for example in the aforementioned container by this, and generating of aggravation of the quality by

electron beam irradiation can be prevented, and its equipment also in that in which the thickness of the aforementioned irradiated object differs.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, the amount of electron ray absorption uniform [the amount of electron ray absorption in the whole irradiated object] and required is obtained like a publication above by making it correspond to the different thickness or the different amount of electron ray transparency in a scanning direction of an irradiated object, and controlling a scan speed.

[0057] By this, when the aforementioned irradiated objects are food and a drink container, uniform sterilization capacity is acquired in each part of the inside of a container, and generating of sterilization unevenness and deterioration of quality can be prevented.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the electron-beam-irradiation method of irradiating repeating an electron ray in irradiated objects, such as food and a drink container, and carrying out a beam scan, and attaining the desired end, such as sterilization, and its equipment.
[0002]
[Problem(s) to be Solved by the Invention] Research and development in the method of irradiating an electron ray (electron beam) instead of the conventional heat sterilization means as a means to sterilize food and a drink container, carrying out a beam scan on a predetermined deflection square at a container, and sterilizing this container is being done in recent years. This electron-beam-pasteurization means is effective in sterilization of heat-resistant low resin containers, such as a PET bottle, etc.
[0003] Such beam scan type electron-beam-irradiation equipment is sterilizing by continuing and irradiating container 20 overall length which is an irradiated object, carrying out a deviation scan with a predetermined deflection angle and a predetermined period with the scanning electromagnet 5 at right and left, after converging the electron beam 2 by which outgoing radiation was carried out from electron beam generating / accelerator 1 in the diameter direction with the convergence electromagnet 4, as shown in drawing 1 .
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[0005] In addition, time series change with the aforementioned scanning wave (angle theta) and angular velocity omega is shown in drawing 9 and drawing 10 . When the scanning angle theta is a sine wave as are shown in drawing 9 , and angular velocity omega serves as constant value which was able to be distributed to positive/negative in the shape of a square wave pulse when the scanning wave theta is a triangular wave, and shown in drawing 10 , angular velocity omega serves as this and a cosine wave which shifted 90-degree phase.
[0006] when [appropriate] it is alike, the scanning electron beam (scanning electron ray) 8 is repeated by such scanning wave, it scans a predetermined period and it irradiates, generally the drink containers 20 of the thickness of the regio oralis of a container or a pars basilaris ossis occipitalis, such as a PET bottle, are thick, since the thickness of the fuselage section is thin, the amount of electron ray transparency of a heavy-gage part is small, the amount of transparency of a thin-walled part becomes large, and the electron ray absorbed dose inside a container does not serve as homogeneity In this case, since the electron ray absorbed dose required for sterilization is beyond a certain decided value, if it is going to secure a complement in a heavy-gage circles side, the electron ray absorbed dose of a thin-walled part will become excessive, and will produce bad influences, such as the weakened bottle quality of the material and discoloration. On the other hand, when securing the electron ray absorbed dose of a limit required for a thin-walled part inside, the bad influence from which the electron ray absorbed dose of a heavy-gage part becomes insufficient, and it becomes inadequate sterilizing it will be produced.

[0007] In a thing this inventi[illegible] irradiated repeating an electron ray in t[illegible]edetermined direction in irradiated objects, such as food and a drink container, and carrying out a beam scan in view of the technical problem of this conventional technology, and attains the desired end, such as sterilization, -- It aims at offering the electron-beam-irradiation method that equalization of the electron ray absorbed dose of each part grade of a scanning direction is enabled, and there is no sterilization unevenness, for example in the aforementioned container by this, and generating of aggravation of the quality by electron beam irradiation can be prevented, and its equipment also in that from which the thickness of the aforementioned irradiated object differs.

[0008]

[Means for Solving the Problem] Order is explained to this invention for ****** progress later on. The thickness T pattern of the direction of height H of the drink containers 20, such as a PET bottle, is shown in drawing 6 as instantiation of an irradiated object. Namely, T (solid line) of a horizontal axis is the thickness on drawing 6 and corresponding to height H of a container 20. For the thickness between T1, and height h1 - h2, the thickness between T2, and height h2 - h3 is [the thickness of a before / from the central point Pb / height h1] T3 and height Pb-h4 to the height direction of this container 20. The thickness between T4, and height h4 - h5 is / the thickness of a between / T5.

[0009] The relation between the scanning-direction part h1 from which the thickness T (solid line) shown in drawing 6 of Baseline Cc and the direction of height H which connects the scanning central point Pe of the scanning electron beam 8 and the direction central point Pb of height H of a container 20 to drawing 7 to the container 20 shown in drawing 6 changes, and the angle which --h5 make is shown. In drawing 7 Namely, angle =theta1 with the part h1 of the aforementioned baseline Cc and the direction of height H, i.e., a scanning direction, to make, Angle =theta2 of Cc and h2 to make, angle =theta3 of Cc and h3 to make, angle =theta4 of Cc and h4 to make, the angle of Cc and h5 to make = like theta 5, the relation with the angle theta with the baseline Cc which passes along each part grade h of a scanning direction and the scanning center line Pe of a container to make is set up.

[0010] If the scanning wave [as opposed to Time-axis t for the scanning pattern of the electron beam 8 in the equipment now shown in drawing 1] theta is made into a triangular wave as shown in drawing 9 , angular velocity omega will serve as constant value of positive/negative so that it may see to drawing 9 . therefore, the above -- when the electron ray of a certain energy (KeV) is irradiated with the fixed angular velocity omega at a container 20, the amount (%) in which an electron ray penetrates each thick section of a container 20 is shown in drawing 8 Amount of transparency E [as opposed to / drawing 8 shows the transmission curve of an electron ray here, and / as opposed to / the surface density (kg/cm2) of an irradiated object / to a horizontal axis] the irradiated object front face of an electron ray to a vertical axis / (%) is expressed. Amount of transparency E (%) and surface density R (kg/cm2) will be in inverse proportion to predetermined within the limits so that more clearly than this view.

Amount Ei of transparency, and surface density Ri = almost fixed -- (0)

However, i=1-5[0011] Surface density R (kg/cm2) is expressed with the specific gravity nu of an irradiated object (kg/cm3), and thickness T (cm) as shown in the following formula (1). In the case of containers, such as a PET bottle, since every part of a container is fixed, specific gravity nu (kg/cm3) can read surface density R (kg/cm2) at thickness T (cm).

R=nu-S-T/S (specific gravity, area and thickness / area)

= Nu-T (kg/cm2) -- (1)

[0012] (0) From a formula and (1) formula, amount of transparency E (%) and thickness T (cm) will be mostly in inverse proportion to predetermined within the limits.

Amount Ei of transparency, and thickness T = almost fixed -- (0')

However, i=1-5[0013] When it returns, and the beam scan of the electron ray of fixed energy is carried out so that clearly from drawing 8 , amount [in the thickness T1-T5 of each part grade of a container 20] of electron ray transparency E (%) is set to E1-E5, respectively, and differing greatly at each part grade is shown. On the other hand, although the sterilization capacity by electron beam irradiation is proportional to the electron ray absorbed dose D of an irradiated object (KGy), this electron ray absorbed dose D (KGy) is in direct proportion to amount of electron ray transparency E (%), as shown in a formula (2), and amount of electron ray transparency E (%) is in inverse proportion to the passage speed V of the irradiated lifter of an electron ray (cm/sec).

DnuE/V -- (2)
(The amount of line absorbed-dose nu transparency / speed) (nu : proportionality)
[0014] Moreover, this passage speed V (cm/sec) is proportional to the scanning angular velocity omega (degree/sec) mostly, as shown in drawing 7 and the following formula (3).
V=L-omega -- (3)
Here, it is L:regularity (distance of the scanning central point Pe and the center line point Pb of a container 20).
omega (degree/sec): Scanning angular velocity of an electron beam [0015] Therefore, as electron ray absorbed-dose:D (KGy) is shown in a formula 4 from the above-mentioned formula (2) and a formula (3), it can be in direct proportion to amount of electron ray transparency:E (%), and it can be said that it is mostly in inverse proportion to the scanning angular velocity omega of an electron beam (degree/sec).

DnuE/omega (nu : proportionality) -- (4)
[0016] If beam scanning angular-velocity:omega (sec-1) which carries out a deer and shows the electron beam 8 of a certain fixed energy (KeV) to drawing 9 irradiates a container 20 by the fixed scanning wave (triangular wave) Electron ray absorbed dose of each part grade of this container 20 : D (KGy) In the aforementioned formula (4), when angular velocity omega is fixed, become a form proportional to amount of electron ray transparency E (%), and amount of electron ray transparency E (%) so that more clearly than the aforementioned formula (0') Since it is in inverse proportion to the thickness T1-T5 of each part grade of a container 20, as shown in drawing 11 , the electron ray absorbed dose D (KGy) is set to D1-D5, respectively, and it will differ greatly at each part grade.
[0017] Electron-ray absorbed dose required here: D (KGy)D1 When are carried out and angular velocity is set as (omega=omega 1) by the part of 0-theta1 expressed with the scanning angle theta base of a container 20 D=D1 If a beam energy is set up and this is made into criteria data so that the electron ray absorbed dose may be obtained Angular velocity omega 2 in the scanning part of the above theta1-theta2 When it is set as omega2=omega1 (E2/E1), the amount absorbed dose of electrons is D1 formula [following] (5) So that it may be shown. It becomes and is in agreement with the required amount absorbed dose of electrons.
D2 =E2-/omega2=E2/{omega1x (E2/E1)}
= E1/omega1=D1 (5)
[0018] It is angular velocity like the following omega3=omega1x (E3/E1) and scanning angle 0-theta4 By the part of the range, angular velocity omega4=omega1x (E4/E1), By setting angular velocity as omega5=omega1x (E5/E1), respectively by the part of the range of the scanning angles theta4-theta5, it is electron ray absorbed-dose:D (KGy) of all parts Required amount =Dof electrons 1 It becomes possible to carry out.
[0019] Moreover, amount of transparency E (%) and thickness T (cm) is the angular velocity omega 2 in the scanning part of the above theta1-theta2 since it is mostly in inverse proportion. Even if it sets it as omega2=omega1 (T1/T2), the amount absorbed dose of electrons is D1. It becomes and is in agreement with the required amount absorbed dose of electrons. It is angular velocity like the following omega3=omega1x (T1/T3) and scanning angle 0-theta4 By the part of the range, angular velocity omega4=omega1x (T1/T4), By setting angular velocity as omega5=omega1x (T1/T5), respectively by the part of the range of the scanning angles theta4-theta5, it is electron ray absorbed-dose:D (KGy) of all parts Required amount =Dof electrons 1 It becomes possible to carry out.
[0020] As mentioned above, the height direction of a container 20, i.e., scanning angular-velocity:omega of the electron beam 8 in each part grade h of a scanning direction, is controlled to change corresponding to amount [of the aforementioned each part grade of a container] of electron ray transparency E (%), or thickness T (Ttheta), the electron ray absorbed dose D of each part is got blocked, and it is D=E/omega necessary electron ray absorbed-dose:D1. It can hold uniformly and the scanning electron beam 8 can be irradiated at a container 20.
[0021] in this case, thickness T1 -- of the direction which intersects perpendicularly with a container medial axis (baseline Cc) as it is indicated in the two-dot chain line of drawing 6 as aforementioned thickness Ttheta -- thickness Ttheta1 of not T5 but the scanning angle direction -- Ttheta5 it is -- a thing is desirable

[0022] The reason is the thickness T1 of the direction which intersects perpendicularly with Baseline Cc if an electron beam carries out a parallel displacement to Baseline Cc. -- Although T5 is sufficient, since it is that by which a beam scan is carried out on a predetermined deflection square a center [the scanning central point Pe], the more the scanning angle theta becomes large, the more the beam included in a container will incline and carry out incidence of the electron beam in practice.
[0023] therefore, the thickness Ttheta1--Ttheta5 of the scanning angle direction -- about -- Ttheta1 -- Ttheta5= "T1 --T5/costheta1 --theta5" --(6)' will come out comparatively and it will increase.
[0024] Moreover, a vessel-wall side has the bulge section and a converging section rather than has parallel all along with a container medial axis, and the wall surface of the portion inclines. Therefore, the thickness Ttheta2 of the scanning angle direction of the container which inclines at the scanning angle and the angle approaching parallel like the thickness Ttheta2 between height h1 - h2 and the thickness Ttheta5 between height h4 - h5, and Ttheta5 become still thicker. Therefore, it is necessary to calculate the thickness Ttheta1--Ttheta5 of the scanning angle direction in consideration of degree of tilt angle thetaalpha of the aforementioned container thickness. Therefore, only the formula of (6)' is insufficient for the thickness Ttheta1--Ttheta5 of the scanning angle direction, and it is necessary to ask for it by following the (6) formula in consideration of degree of tilt angle thetaalpha of the thick part of a container.
Ttheta1--Ttheta5 = "T1 --T5/cos (theta1+thetaalpha1) -- (theta5+thetaalpha5)" -- (6)
[0025] In this case, it is good to carry out minute division of scanning angle thetan and the thick degree of tilt angle thetan, for asking with a more sufficient precision, and to ask for Tthetan and angular-velocity omegan. Especially when the container is formed on the curved surface like the thickness Ttheta5 between height h4 - h5, it is good to carry out minute division of scanning angle thetan and the thick degree of tilt angle thetan, and to ask for Tthetan and angular-velocity omegan.
[0026] Furthermore, consideration of the aforementioned thickness takes into consideration from Baseline Cc about thickness Ttheta of vessel-wall 20A by the side of the vertical half by the side of the scanning central point Pe. Therefore, although the aforementioned consideration is sufficient as this consideration when irradiating an electron beam, while a container rotates Baseline Cc as a center, when irradiating an electron beam, without a container rotating, it must take into consideration from Baseline Cc also about thick Ththeta of vessel-wall 20B by the side of the vertical half of a scanning central point Pe opposite side. That is, it is the scanning angle theta 1 from Baseline Cc also about thick Ththeta of vessel-wall 20B by the side of the vertical half of a scanning central point Pe opposite side. -- It is based on thick degree of tilt angle thetabeta of theta 5 and the aforementioned container opposite-side 20B, and is a simultaneously. Ththeta1 -- Ththeta5 = "T1 --T5/cos (theta1+thetabeta1) -- (theta5+thetabeta5)" -- (6)
It becomes.
[0027] Therefore, the container thickness of the original scanning direction which should determine angular velocity omega becomes a value (Ttheta+Ththeta) adding thickness Ttheta of vertical half vessel-wall 20A by the side of the scanning central point Pe, and thick Ththeta of vessel-wall 20B of the opposite side from Baseline Cc.
[0028] From the aforementioned result, it is the aforementioned 0 degree-theta1. The thickness of a scanning direction required to determine the angular velocity omega 1 corresponding to the required amount D of amount absorption of electrons of a part is set to (Ttheta1+Ththeta1). The thickness of a scanning direction required to determine the angular velocity omega 2 corresponding to the required amount D of amount absorption of electrons of the part of theta1-theta2 is set to (Ttheta2+Ththeta2). Since the following becomes [the part of the range of (Ttheta4+Ththeta4) and the scanning angles theta4-theta5] the same the thickness of (Ttheta5+Ththeta5) by the part of the range of (Ttheta3+Ththeta3) scanning angle 0-theta4 by the part of the range of the scanning angles theta2-theta3, It corresponds to this thickness (Ttheta2+Ththeta2) - (Ttheta5+Ththeta5), and they are angular velocity omega 2 - omega5. By setting up, respectively, it is the amount D of electron ray absorption of all parts (KGy) Required amount =Dof electrons 1 It becomes possible to carry out.
[0029] In order that this invention may solve this technical problem, its attention is paid to the thickness of an irradiated object in invention according to claim 1. In the electron-beam-irradiation method of irradiating irradiated objects, such as the aforementioned food and a drink container, repeating an

electron ray and carrying out a beam scan, and attaining the desired end, such as sterilization The scan speed of the aforementioned electron ray is characterized into the thickness of an irradiated object, and make it correspond to the thickness of an abbreviation scanning direction preferably, and it is made to change in abbreviation inverse proportion, and is characterized by making the amount of electron ray absorption of this irradiated object equalize mostly. In addition, the aforementioned thickness is the thickness T1 of the direction which intersects perpendicularly with Baseline Cc in order to attain simplification. -- although there is especially no problem even if it adopts T5, since it is that by which the beam scan of the electron beam is carried out on a predetermined deflection square a center [the scanning central point Pe] preferably It is more desirable to use the thickness Ttheta1--Ttheta5 of the scanning angle direction or (Ttheta1+Ththeta1) -- (Ttheta5+Ththeta5).

[0030] In the electron-beam-irradiation method that irradiate invention according to claim 2, repeating an electron ray and carrying out a beam scan, and it attains the desired end, such as sterilization, in irradiated objects, such as food and a drink container, paying attention to the amount of electron ray transparency (rate) Make the scan speed of the aforementioned electron ray equivalent to the amount of electron ray transparency to an irradiated object (rate), and it is made to change in abbreviation direct proportion, and is characterized by making the electron ray absorbed dose of this irradiated object equalize mostly.

[0031] in addition, the above -- as for any invention, it is good to constitute so that may set up the scanning period needed beforehand as data, an adjustment factor may be computed by this scanning period and total of the scan time in each part grade of a scanning direction of the aforementioned irradiated object computed from the distance and the scan speed to the aforementioned scanning direction, this adjustment factor may adjust the scan time for every aforementioned each part grade and one scan may be made to complete in the aforementioned scanning period

[0032] Invention according to claim 3 is a thing about the equipment for inventing the claim 1 aforementioned publication effectively. The electron ray generating means which carries out outgoing radiation of the straight-line-like electron ray (beam), and the beam scanning means which carries out a beam scan repeatedly on an aforementioned electron beam predetermined deflection square by magnetic field control, The driver voltage impressed to the aforementioned beam scanning means is controlled, and the aforementioned beam scan speed is characterized by the bird clapper from the thickness of an irradiated object, and the scanning beam control means which are made to correspond to the thickness of an abbreviation scanning direction preferably, and are changed in abbreviation inverse proportion.

[0033] Invention according to claim 4 is a thing about the equipment for inventing the claim 2 aforementioned publication effectively. The electron ray generating means which carries out outgoing radiation of the straight-line-like electron ray (beam), and the beam scanning means which carries out a beam scan repeatedly on an aforementioned electron beam predetermined deflection square by magnetic field control, The driver voltage impressed to the aforementioned beam scanning means is controlled, and it is characterized by the bird clapper from the scanning beam control means to which the aforementioned beam scan speed is made equivalent to the amount of electron ray transparency to an irradiated object (rate), and is changed in abbreviation direct proportion.

[0034]

[Embodiments of the Invention] Hereafter, with reference to a drawing, the suitable operation form of this invention is explained in detail in instantiation. However, the size of the component part indicated by this operation form, the quality of the material, a configuration, its relative arrangement, etc. are not the meaning that limits the range of this invention to it but only the mere examples of explanation, as long as there is no specific publication especially.

[0035] Drawing 1 -5 show the beam scan type electron-beam-irradiation equipment concerning the operation form of this invention, and drawing 1 is [the block diagram (block diagram) of scanning profile control equipment, drawing 3 - drawing 5 of the whole block diagram and drawing 2] the control-block views or flow chart views of scanning profile control equipment.

[0036] It has the electron gun which are electron beam generating / accelerator with which 1 generates an electron beam 2 in drawing 1 , for example, carries out outgoing radiation of the electron gun, the acceleration tube which accelerates the electron beam by which outgoing radiation was carried out from the electron gun so that it may have predetermined energy, and the klystron which supplies the

microwave energy for accelerating the aforementioned electron beam to the acceleration tube. And if the electron beam 2 by which acceleration was carried out [aforementioned] is led to the convergence electromagnet 4 (beam drawing lens) through the tubed beamguide cylinder 3 and the aforementioned electron beam 2 is converged and put in another way in the diameter direction, it will make drawing of a beam perform and narrow-diameter-ize, and will attain densification of energy.

[0037] The control signal control a beam scan speed in case this deviation scan is carried out, although it is the translation by which the convergence electron beam by which densification was carried out with the aforementioned convergence electromagnet 4 sways with a predetermined deflection angle with the scanning electromagnet 5, and a deviation scan is carried out on frequency (both-way deviation frequency), and control the applied voltage to the aforementioned scanning electromagnet 5 in order in other words to control angular velocity is made to incorporate from scanning profile control equipment 10. And the scanning electron beam 8 by which the deviation scan was carried out while controlling angular velocity is irradiated scanning in the direction of a baseline of a container 20 through flat truncated-cone-like the scanning horn 6 and the drawing aperture 7, and performs predetermined sterilization operation. Under the present circumstances, the irradiation of all container walls of the aforementioned container 20 is attained by rotating the diameter direction center line Cb as a medial axis.

[0038] The aforementioned scanning profile control equipment 10 is constituted like drawing 2 , and the central arithmetic unit (CPU) with which 30 performs various operations, and 31 are the memory connected to this computer 30, and it consists of RAM which stores data calculated by ROM in which the program which performs predetermined control action, and said various operation expression are stored, initial value, the aforementioned operation expression of a container, such as a profile, etc., such as container thickness and angular velocity, in drawing 2 . The timer 32, D/A converter 33, and the digital input interface 35 are connected to the above CPU 30 through the I/O data bus 36.

[0039] And a scanning command signal (ON/OFF signal) is incorporated through the digital input interface 35, and this scanning command signal is inputted into CPU30 through the I/O data bus 36. Moreover, the digital control signal from this CPU30 is changed into an analog signal in D/A converter 33 through the I/O data bus 36, and forms the magnetic field for the driver voltage corresponding to the control signal generated by the above CPU 30 with the driver circuit 34 being generated, impressing this driver voltage to the scanning electromagnet 5, and carrying out deviation operation of the aforementioned electron beam 2 with this analog signal.

[0040] Next, the control algorithm of the scanning profile control equipment 10 in the beam scan type electronic-line-scanning equipment which consists of this composition is based and explained in the control-block view of drawing 3 - drawing 5 . although the irradiated object was used as the drink container 20 and the case where the thick different number of parts is five is stated in this example, this invention comes out not to mention not being limited to five

[0041] In drawing 3 , 10a is the initial-data setting section, and the setting data of the amount of transparency of an electron ray which the setting data of the scanning angle (theta) pattern which degree of tilt angle thetaalpha of container thickness shows to drawing 7 from the scanning angle setting section 42 if needed [of a thickness (T) pattern / the setting data and if needed] for a container 20 which are shown in drawing 6 from the thick pattern setting section 41 show to drawing 8 from the amount setting section 43 of electron ray transparency are inputted In addition, the aforementioned thick pattern setting section 41, the scanning angle setting section 42, and the amount setting section 43 of electron ray transparency are set to the RAM section in which rewriting in memory is possible by each.

[0042] It initial-data setting section 10a Sets [aforementioned], and is based on an input signal from the thick pattern setting section 41, the scanning angle setting section 42, and the amount setting section 43 of electron ray transparency. as an initial data The distance L from the scanning-direction central point Pb of a container 20 to the scanning central point Pe of an electron beam 8 Distance Hi (H1-H5), i.e., height, between the scanning-direction central point Pb of a container 20, and each thick part hi, Degree of tilt angle thetaalpha of each container thick part, the amount Ei (E1-E5) of electron ray (beam) transparency of each part grade of a container in the energy (KeV) which carries out electronic sterilization of the container 20 (%), The target scan speed V1 (cm/s) of the thinnest part (this operation form part of T1) of a container 20, the actual scanning period tf at the time of electronic sterilization, etc.

are set up as initial value.

[0043] In angle transducer 10b, it is based on the set point of the initial data incorporated from aforementioned initial-data setting section 10a, and they are scanning angle thetai and the reference-angle speed omega 1. It asks. Each part grades h1 and h2 of a scanning direction of the aforementioned container 20 -- hi and angle:thetai with the baseline Cc passing through the aforementioned scanning central point Pe to make are thetai=tan -1 (Hi/L). (2)

here -- the height to each part grade hi of the Hi(H1, H2, H3 --) = aforementioned scanning direction, however i=1-5 -- again -- aforementioned target scan speed: -- angular-velocity:omega1 corresponding to V1 -- omega1=V1/L (3)

[0044] So that the amount D of electron ray absorption (KGy) in each aforementioned each part grades h1 and h2 (thickness : T1, T2 --) of a scanning direction may be made the same as that of a part h1 (i= 1) by amendment angular-velocity operation part 10c It is the reference-angle speed omega 1 from angle transducer 10from the amount setting section 43 of electron ray transparency b about the amounts E2-E5 of electron ray transparency of parts h2-h5. It incorporates, respectively and the amendment angles omega2-omega5 are computed with the following formula (4).

omega 2 - omega5=omega1x (E2-E5/E1) (4)

[0045] In addition, in order to attain simplification of an operation in this example, it is the thickness Ttheta1 of the scanning angle direction. -- Ttheta5 Setting map data of the aforementioned thickness (T) pattern, It is the thickness T1 of the direction which specifically intersects perpendicularly with a container medial axis (baseline Cc). -- It is the thickness T2 which regards it as T5 and corresponds from the amount setting section 43 of electron ray transparency. -- Although the amounts E2-E5 of electron ray transparency of T5 part are calculated directly In practice, it is good to ask for the thickness Ttheta2--Ttheta5 of the scanning angle direction based on the following formula, and to ask for the amendment angular velocity omega2-omega5 based on the amount Etheta2 to Etheta5 of electron ray transparency amended based on the thickness Ttheta2--Ttheta5 of this scanning angle direction.

[0046] That is, based on the setting map data of the aforementioned thickness (T) pattern, and the setting map data of a scanning angle (theta) pattern, it is first based on explaining more concretely at following the (6)' formula, and is the thickness Ttheta2 of the scanning angle direction. -- Ttheta5 is calculated.

Ttheta2 -- Ttheta5= "T2 --T5/Costheta2 --theta5" -- (6) Thickness Ttheta2 of ', therefore the scanning angle direction -- As for Ttheta5, it is desirable to calculate in consideration of degree of tilt angle thetaalpha of the aforementioned container thickness, and it is calculated by following the (6) formula which took into consideration degree of tilt angle thetaalpha in this case.

Ttheta2--Ttheta5 = "T2 --T5/Cos (theta2+thetaalpha2) -- (theta5+thetaalpha5)" -- (6)

[0047] Next, the aforementioned thickness T2 -- The amounts E2-E5 of electron ray transparency of T5 part and the amount Etheta2 to Etheta5 of electron ray transparency corresponding to the thickness Ttheta2--Ttheta5 of the scanning angle direction are calculated. Based on the following formula, it can ask for the accurate amendment angular velocity omega2-omega5 from Etheta2-Etheta5=(E2-E5) x (Ttheta2 to Ttheta5)/(T2-T5), and the above Etheta2 to Etheta5.

omega 2 - omega5=omega1x (Etheta2-Etheta5/E1) -- (4')

[0048] In 10d of relative scan-time operation part, the relative scan time ti is computed from scanning angle thetai inputted from aforementioned angle transducer 10b and amendment angular-velocity operation part 10c, and angular-velocity omega i, and the operation shown in the following formula (8) is performed.

t1=theta1/omega1t2=(theta2-theta1)/omega2t3=(theta3-theta2)/omega3t4=theta4/omega4t5= (theta5-theta4) / omega 5 -- (8)

[0049] At timing coefficient operation part 10e, they are the aforementioned each part grades h1 and h2. -- h5 The adjustment factor C for doubling the total value of a scan time ti (t1 and t2 --t5) with the actual scanning period tf is computed, and the operation shown in the following [-one number] formula is performed.

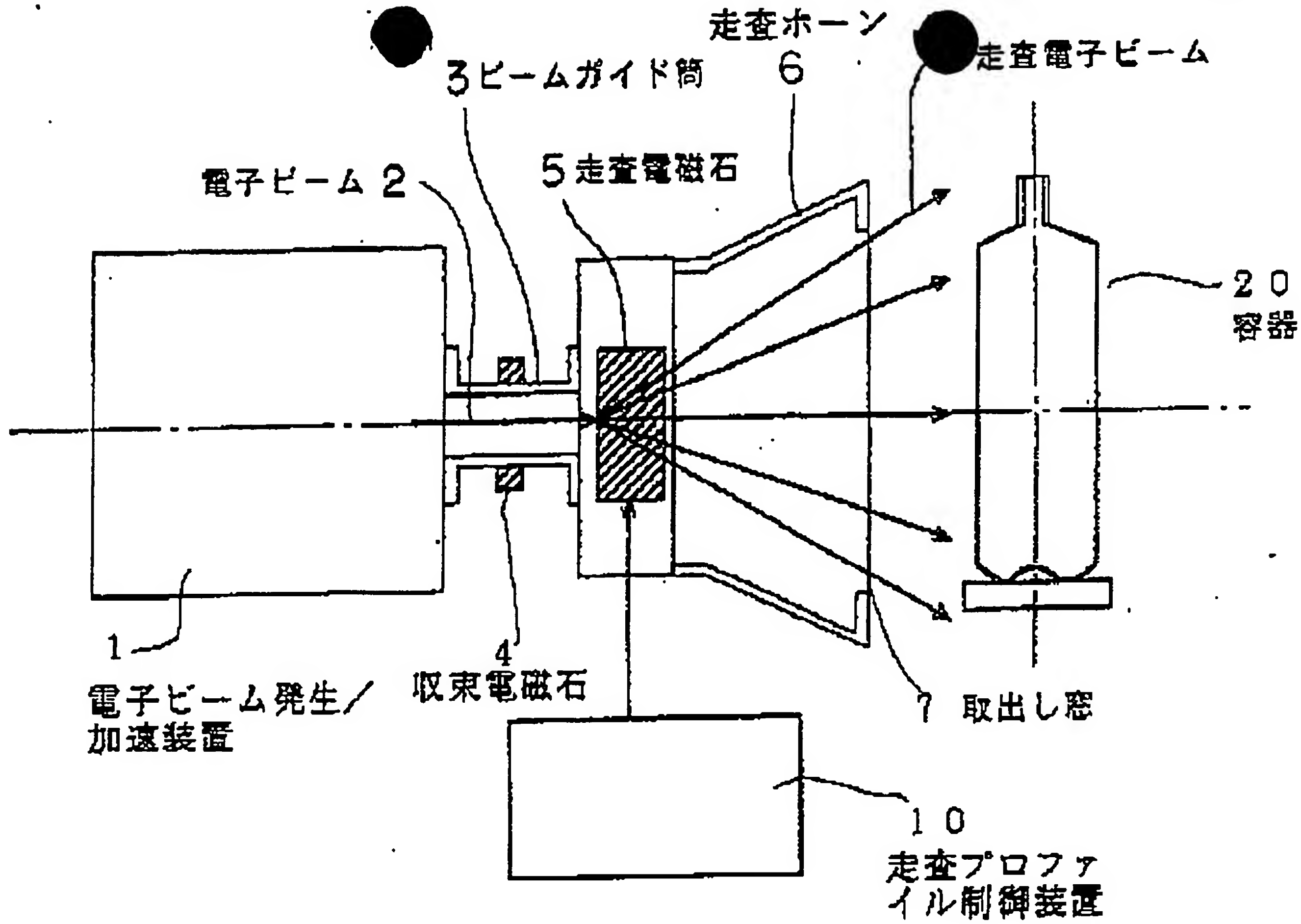
[0050]

[Equation 1]

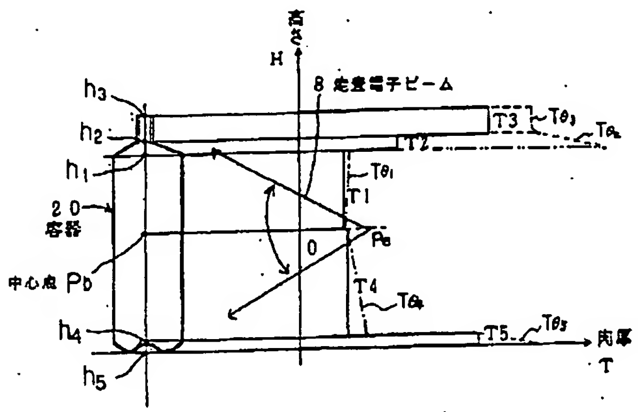
$C = tf / (2 \cdot \Sigma ti)$
但し ($i = 1 \sim 5$)

[0051] The aforementioned each part grades h1 and h2 doubled with the actual scanning period tf in 10f of real scan-time setting sections using the adjustment factor C inputted from aforementioned timing coefficient operation part 10e -- h5 The real scan time tfi is computed and an operation with the following formula (10) is performed.
tfi=Cxti (i=1-5) -- (10)
[0052] In 10g of scanning corrugating sections, as shown in drawing 12 , the scanning wave corresponding to the scan speed doubled with the actual scanning period tf is formed from the relative scan time ti (t1 --t5) which is the above, and was made and computed, and scanning angle thetai (theta1 --theta5).
[0053] 10h is the scanning wave generating section, and if ON scanning signal is inputted into CPU30 from the digital input interface 35 from the exterior, it will output the control signal for carrying out the deviation scan of the electron ray based on the scanning wave which is the above, and was made and computed with the scan speed based on the scanning wave shown in drawing 12 by carrying out a deviation scan. In addition, when a scanning signal is OFF, the signal of the aforementioned scanning angle theta= 0 is outputted, and a deviation scan is not performed.
[0054] 10j is an output voltage transducer and outputs the digital signal which changed into the voltage value the angle data of the scanning wave outputted from the 10h of the aforementioned scanning wave generating sections to D/A converter 33.
[0055] And it is changed into an analog signal by aforementioned D/A converter 33, the control voltage which corresponds through a driver 34 is impressed to the scanning electromagnet 5, and the magnetic field strength for deviation control of a beam is controlled.
[0056]
[Effect of the Invention] According to this invention, the electron ray absorbed dose uniform [the electron ray absorbed dose in the whole irradiated object] and required is obtained like a publication above by making it correspond to the different thickness or the different amount of electron ray transparency in a scanning direction of an irradiated object, and controlling a scan speed.
[0057] By this, when the aforementioned irradiated objects are food and a drink container, uniform sterilization capacity is acquired in each part of the inside of a container, and generating of sterilization unevenness and deterioration of quality can be prevented.

[Translation done.]


走査ホーン
走査電子ビーム
3ビームガイド筒
6
電子ビーム 2
5走査電磁石
20
容器
1
電子ビーム発生／
加速装置
4
収束電磁石
7 取出し窓
10
走査プロファ
イル制御装置

Drawing selection drawing 6



[Translation done.]